

CLAIMS

I claim:

1. An apparatus for electronic wafer chemical-mechanical-planarization table process monitoring comprising:
 - a. a polishing pad and a hub;
 - b. the polishing pad having a polishing surface and an attachment surface and containing an embedded waveguide with an outer lens fixture end with a means for delivering light and a light coupling center fixture end;
 - c. the waveguide is arranged within the pad interior such that the center fixture end and outer lens fixture end is embedded within a recess on the pad polishing surface such that the ends are located on the pad polishing surface;
 - d. the waveguide is arranged within the pad interior such that the center fixture end is at the center of rotation of the polishing pad and the outer lens fixture end is at a location within the wafer track;
 - e. the hub contains a rotating portion and a stationary portion rotatably connected and arranged such that the rotating portion positions the stationary portion wherein light may be transmitted from the hub stationary portion to the waveguide center fixture end and light may be transmitted from the waveguide center fixture end to the hub stationary portion wherein when the waveguide is opposite a wafer contacting the surface of the polishing pad, the hub stationary portion provides light to and receives surface reflectance from the wafer;
 - f. the stationary portion contains an opto-electronic device positioned in proximity to the table polishing pad waveguide entrance wherein the opto-electronic device contains a light source to provide the light transmitted from the hub stationary portion, and wherein the opto-electronic device receives the light transmitted from the waveguide transparent center fixture; and
 - g. the opto-electronic device contains means for converting the received light into an electrical signal derived from the light, and transmitting the amplified, processed electronic signal on a conductor.
2. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 1 further comprising the hub contains an angular position encoder

arranged with means for conducting electronic signals to and from the hub stationary portion to a stationary portion of the table.

3. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 2 further comprising the hub contains means for analysis of the electronic signals wherein the state of the electronic wafer polishing may be derived from the electronic signal derived from the light and wherein the polishing pad direction, angle, and speed may be derived from the electronic signal from the angular position encoder.
4. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 3 further comprising the hub is attached to the polishing pad by vacuum.
5. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 4 further comprising the hub is positioned on the polishing pad by a plurality of locating dowels and corresponding locating holes in the polishing pad and hub.
6. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 4 further comprising the hub is positioned on the polishing pad by a locator ridge on the opto-electronic device lower surface and a corresponding locator groove in the polishing pad light coupling center fixture.
7. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 4 further comprising the hub is positioned on the polishing pad by a locator ridge on the opto-electronic device lower surface and a corresponding locator groove in the polishing pad light coupling center fixture and by a plurality of locating dowels and corresponding locating holes in the polishing pad and hub.
8. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 4 further comprising the hub rotating portion is arranged with means for preventing leakage of slurry contaminates between the hub rotating portion and the polishing pad.
9. An apparatus for electronic wafer chemical-mechanical-planarization table process monitoring comprising:
 - a. a polishing pad and a hub;

- b. the polishing pad having a polishing surface and an attachment surface and containing an embedded waveguide with an outer lens fixture end with a means for delivering light and a light coupling center fixture end;
 - c. the waveguide is arranged within the pad interior such that the center fixture end and outer lens fixture end is embedded within a recess on the pad polishing surface such that the ends are located on the pad polishing surface;
 - d. the waveguide is arranged within the pad interior such that the center fixture end is at the center of rotation of the polishing pad and the outer lens fixture end is at a location within the wafer track;
 - e. the hub contains a rotating portion and a stationary portion rotatably connected and arranged such that the rotating portion positions the stationary portion wherein light may be transmitted from the hub stationary portion to the waveguide center fixture end and light may be transmitted from the waveguide center fixture end to the hub stationary portion wherein when the waveguide is opposite a wafer contacting the surface of the polishing pad, the hub stationary portion provides light to and receives surface reflectance from the wafer;
 - f. the stationary portion contains means for transmitting the light received from the waveguide center fixture to a stationary portion of the table, and
 - g. the hub is positioned on the polishing pad by a locator ridge on the positioning keyway and a corresponding locator groove in the polishing pad light coupling center fixture.
10. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 9 further comprising the hub is positioned on the polishing pad by a locator ridge on the opto-electronic device lower surface and a corresponding locator groove in the polishing pad light coupling center fixture and by a plurality of locating dowels and corresponding locating holes in the polishing pad and hub..
11. The apparatus for electronic wafer chemical-mechanical-planarization table process monitoring as in claim 9 further comprising the hub rotating portion is removably attached to the polishing pad by vacuum, the hub rotating portion arranged with means for preventing leakage of slurry contaminates between the hub rotating portion and the polishing pad.

12. An optical signal delivery and retrieval system to measure wafer surface reflectivity on a rotating planarization table comprising:
- means for providing light to the surface of a rotating wafer polishing pad;
 - means for receiving reflected light from the wafer surface in contact with the rotating pad surface;
 - means for conducting the light providing means and light receiving means through the center of rotation of the polishing pad;
 - means for converting the received light to an electronic signal; and
 - means for conducting the electronic signal to a chemical-mechanical-planarization tool control system.
13. An optical signal delivery and retrieval system to measure wafer surface reflectivity on a rotating planarization table as in claim 12 further comprising means for analyzing the electronic signal, and means for conducting the analyzed electronic signal to a chemical-mechanical-planarization tool control system.
14. An optical signal delivery and retrieval system to measure wafer surface reflectivity on a rotating planarization table as in claim 12 further comprising means for sensing the position of the polishing pad surface light providing means and light receiving means.
15. An optical signal delivery and retrieval system to measure wafer surface reflectivity on a rotating planarization table as in claim 12 further comprising means for preventing leakage of slurry contaminates between the hub rotating portion and the polishing pad.
16. An optical signal delivery and retrieval system to measure wafer surface reflectivity on a rotating planarization table as in claim 13 further comprising means for sensing the position of the polishing pad surface light providing means and light receiving means.
17. An optical signal delivery and retrieval system to measure wafer surface reflectivity on a rotating planarization table as in claim 13 further comprising means for directing leakage of slurry contaminates to a by-pass path wherein slurry contaminate leakage flows through the by-pass path.
18. An optical signal delivery and retrieval system to measure wafer surface reflectivity on a rotating planarization table comprising:
- means for providing light to the surface of a rotating wafer polishing pad;

- b. means for receiving reflected light from the wafer surface in contact with the rotating pad surface;
 - c. means for conducting the light providing means and light receiving means through the center of rotation of the polishing pad;
 - d. means for conducting the received light signal to a chemical-mechanical-planarization tool control system;
 - e. means for sensing the position of the wafer surface in relation to the means for providing and receiving light at the polishing pad surface; and
 - f. means for preventing leakage of slurry contaminants between the hub rotating portion and the polishing pad.
19. A method of manufacturing an electronic semiconductor wafer chemical-mechanical-planarization monitoring system comprising:
- a. imbedding a waveguide with a sensing end and a light coupling end in a polishing pad;
 - b. attaching the outer lens fixture end on the polishing pad surface at a location within the pad wafer track;
 - c. locating the waveguide light coupling fixture end on the polishing pad surface at the center of rotation of the polishing pad;
 - d. positioning a hub on the polishing pad over the waveguide light coupling end such that a stationary opto-electronic device within the hub transmits and receives light from the waveguide light coupling end; and
 - e. connecting an electrical conductor from the hub opto-electronic device to a chemical-mechanical-planarization tool control system.
20. The method of manufacturing an electronic semiconductor wafer chemical-mechanical-planarization monitoring system as in claim 19 further comprising arranging a vacuum supply hose to provide a vacuum supply to the hub center of rotation following positioning to attach the hub to the pad.
21. The method of manufacturing an electronic semiconductor wafer chemical-mechanical-planarization monitoring system as in claim 20 further comprising providing a pressure equalizing flow path such that any leakage flow is between the hub pressure equalizing flow path and hub center of rotation vacuum supply.

22. The method of manufacturing an electronic semiconductor wafer chemical-mechanical-planarization monitoring system as in claim 21 further comprising arranging the connections from the hub stationary optical fiber and angular position encoder through the vacuum supply hose.
23. The method of manufacturing an electronic semiconductor wafer chemical-mechanical-planarization monitoring system as in claim 22 further comprising monitoring the signal from the angular position encoder using electronic devices to determine the polishing pad direction, angle, and speed.